SOILutions

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Environmentally Friendly Farming

Today's agricultural systems depend upon inputs of commercial fertilizers and herbicides for optimum crop production. There is no question that our technology based practices have increased agricultural production. Generally, the economic impacts are very positive. However, the ecological impacts are not always positive.

Commercial fertilizers and animal manure are used to increase crop yields and to replace soil nutrients removed with harvested crops. Both have been valuable in reversing the trend of declining soil productivity and soil nutrients. In fact, research has clearly shown that added fertilizers not only increase crop yields but also build soil organic matter.

There is increasing environmental concern over potential contamination of soils, surface water and groundwater with the use of fertilizers, manures and herbicides. New research on environmentally sustainable farming practices is under way to examine these issues. Some of the new projects in Alberta include:

☞ Establishment of long-term crop rotation plots.

☞ Safe manure and fertilizer application rates on dryland and irrigated soils.

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Blackleg of Canola

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Two types of blackleg fungus infect canola - avirulent and virulent. The avirulent or mild type has always been common in canola fields. The disease appears on leaves and stems in August but does not usually cause significant damage.

Virulent blackleg infects canola seedlings and progressively damages the growing crop in June and July. It is a fungal canker or dry rot disease that causes stem girdling and lodging. In heavily infested crops, up to 100 percent of the stems may be infected, resulting in major yield loss. Both types of blackleg cause dead patches that appear as pepper-like spots on canola leaves, pods and stems.

The extent of spread

Virulent blackleg is prevalent in east-central Alberta. A trace to 5 percent levels of blackleg were diagnosed in a third of all crops surveyed in this area during 1993. A crop loss of 85 percent occurred in a field where the producer grew continuous canola. The disease was also found in over 100 fields in the Fahler and Grande Prairie areas in 1993. In western and southern areas of the province the disease is uncommon or nonexistent. In general, yield losses from blackleg in Alberta continue to be minor.

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THIS ISSUE:

Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT

☞ Investigation of nitrate leaching below irrigated fertilized fields in the Bow River Irrigation District.

☞ Using forages to reduce environmental contaminants by recovering nutrients in soil.

☞ Investigation of herbicide leaching into groundwater in central Alberta.

☞ Monitoring of pesticides in surface waters in Alberta.

☞ Minimizing herbicide use by changing crop management practices.

☞ Effect of erosion and tillage systems on nitrate leaching and gaseous oxides of nitrogen emissions.

However, you don't have to wait for results from these projects. You can take a pro-active approach now to minimize the potential negative effects of fertilizers, manures and pesticides on your farm.

High nitrates combined with excess rainfall or irrigation can result in leaching from soils into groundwater. High nitrates in soil occur when manure or commercial fertilizers are applied at rates greater than the crop requires. Some of our suggestions to minimize nitrate leaching include:

Select appropriate application rates:

✔ Soil test to determine soil nitrogen level and determine optimum nitrogen fertilizer and/or manure application rates. Select a realistic yield and apply according to crop requirements.

✔ Take all sources of nitrogen into account, including nitrogen from crop residue and legume plowdown.

✔ Areas of the field that have differences in soil type or management history may require different fertilizer rates. Soil test and fertilize these portions of the field separately.

Optimize your nitrogen application method and timing:

✔ Band rather than broadcast fertilizer.

✔ Apply split applications for long season irrigated crops grown on sandy soils using fertigation.

✔ Split applications for hay and pasture land.

✔ Apply fertilizer and manure in the spring, or just before peak crop demand.

✔ When you apply nitrogen in the fall, wait until late in the fall, when the soil is cooler.

Rotate crops:

✔ Include legumes in your crop rotation to reduce the need for fertilizer application. Nitrate added to soil as legume residues breakdown and can be leached just like nitrate from fertilizer. Generally the release from legume residues is slow so nitrate does not accumulate.

Use animal manure carefully:

✔ Soil test to determine soil nitrate levels and then match estimated nitrogen release from manure with crop nitrogen requirements.

✔ Use conservative rates of manure (eg. on irrigated barley use less than 25 ton/acre.)

✔ Stay a safe distance from surface water when applying liquid (10 meters) or solid (5 meters) manure.

Summerfallow:

✔ Summerfallow has and continues to be a contributor to nitrate leaching. (Quite likely the biggest contributor.) Use flex cropping in the drier areas and continuous cropping in the wetter areas of Alberta to minimize nitrate leaching.

Irrigation management:

✔ Schedule your irrigation to match soil moisture with applied water and crop water requirements.

Phosphate leaching from surface soil into groundwater is not a problem. Phosphate is extremely immobile in soil. It attaches to soil particles as well as other elements such as calcium, iron and aluminum. As a result, phosphate is relatively immobile in soil and is not a nutrient that will leach into groundwater.

However, phosphate can be carried to surface water with sediments, in surface runoff. In most surface waters, urban waste is the major source of phosphate, but runoff from agricultural land can be a potential problem. Ensuring that water and wind erosion do not occur on your farm will prevent contamination of surface waters.

Pesticides in surface waters in Alberta are uncommon. However, routine monitoring of surface waters for pesticides has indicated that there are few problems. Herbicides have been detected in some samples from the Battle River, and in irrigation canals and return flow streams in Southern Alberta. Detected herbicide levels are currently below water quality guidelines for aquatic life and drinking water.

The primary means of herbicide transport into surface waters is by wind and water movement of sediments from fields. Your soil conservation efforts help keep pesticides out of surface waters. When using soil applied herbicides in the fall, keep a good trash cover to help prevent erosion.

Several recent studies have detected herbicides in shallow groundwater below irrigated fields. Leaching occurred when excess water moved through the soil before herbicide break down had occurred. Pesticides that are soluble and persistent (i.e. resist breakdown in the environment) are the most likely to be leached. There are a number of factors that contribute to herbicide movement that you should be aware of to minimize problems on your farm.

Use herbicides with lower solubility and leaching potential. The solubility of some common herbicides are shown in the attached table. More detailed information is contained in the Blue Book (Crop Protection with Chemicals; Agdex 606-1 1994) or is available from the chemical manufacturer.

Pay particular attention to selecting herbicides with lower solubilities, if you are farming soils with high leaching potential. These include:

- Sandy soils or fractured soils with vertical cracks such as clay soils under drier conditions.
- Irrigated soils or soils in high rainfall areas.

Irrigation or significant rainfall shortly (24 hours) after herbicide application can result in greater downward movement of herbicide. You can help prevent ground water contamination with the following practices:

- Delay irrigation for several days after herbicide application.
- Do not apply herbicide if the weather forecast is for heavy rains.

Making sure your sprayer is properly calibrated prevents over application of herbicides and this means less herbicide in the environment. Since most herbicide contamination occurs at point source, using a nurse tank helps avoid back-siphoning from the sprayer tank into your water source. Herbicide spills during tank filling can also contaminate your water source. Prevent this problem by adding the concentrated product at a distance from your water source.

These are few of our thoughts on how you can take a proactive roll in reducing or eliminating the negative effects of fertilizers and herbicides.

If you would like further information feel free to give us a call. We would be more than happy to hear your comments or try to answer any questions you might have.

Contamination Potential of Some Commonly Used Pesticides

Trade Name	Leaching Potential	Trade Name	Leaching Potential
Herbicides		Matavan L	large
Achieve GD	small	Mecoprop	large
Achieve Extra	medium	Muster	large
Afolan	medium	Pardner	small
Ally	large	Poast	small
Atrazine	large	Stampede CM	large
Avadex	medium	Refine Extra	medium
Banvel	large	Refine W.O.	large
Buctril M	large	Reglone	extra small
Blagal	large	Rival	small
Dyvel	large	Roundup	extra small
Edge	small	Rustler	large
Estaprop	medium	Sencor	large
Fortress	small	Target	extra large
Fusilade II-125EC	small	Tordan 202C	large
Gramoxone	extra small	Treflan	small
Henazinone	large	Triumph Plus	large
Hertitage 5G	small	Wrangler	extra small
Hoe-Grass II	large	**Insecticides**	
Hoe-Grass 284	large	Ambush	extra small
Kil-Mor	large	Furadan	large
Laser	large	Pirimor	large
Lexone	large		
Lontrel	large	**Based on Hirschi et al. 1993**	

Ross McKenzie - Soil Fertility Specialist, Lethbridge. 381-5126
Denise Maurice - Supervisor, Weed Research, Edmonton. 427-2530
Elston Solberg - Research Agronomist, Edmonton. 427-2530
Joan Rodvang - Hydrogeologist, Lethbridge. 381-5883
Murray Riddell - Supervisor, Salinity Control, Lethbridge. 381-5884
Graeme Greenlee- Soil Specialist Lethbridge . 381-5893

Crop Diagnostics Video

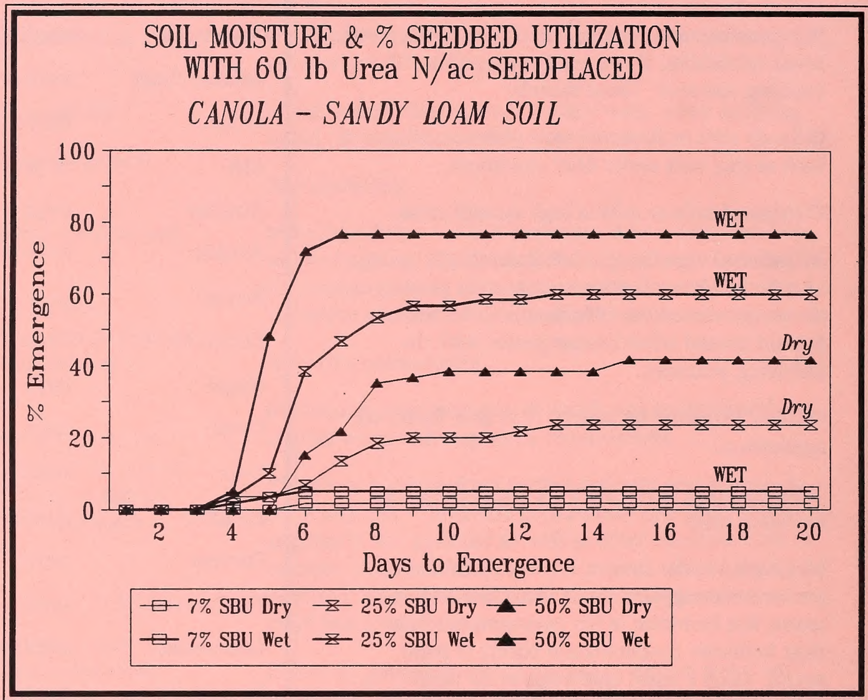
A new video *"Outstanding in Your Field, Diagnosing Crop Problems"* has just been released by Alberta Agriculture Food and Rural Development. The video lays out a logical step by step approach to diagnosing crop production problems.

Loaner copies are available from AAFRD district offices. Should you wish to add this cinematic gem to your video library, copies can be purchased through Rosemary Amerongen, Broadcast Media Branch, Alberta Agriculture Food and Rural Development, 7000-113 Street, Edmonton, Alberta, T6H 5T6. Phone 427-2127.

Nitrogen in the Seedrow

Older research done with press drills in the 1960's showed us that increasing seedrow N causes reduced germination, delayed emergence, delayed maturity. A press drill places fertilizer and seed close together whereas many of today's direct seeding implements scatter the fertilizer and see through a greater percentage of the seedbed. So, the old press drill guidelines don't apply to the bigger seedrow created by the new implements.

"How much fertilizer can I place with my direct seeded crop?" has been **the** most common question asked of agronomists during the past three or four years. To help answer this question, commodity groups, government and industry started a co-operative research project in 1992. Field experiments were laid out at two sites the first year and expanded to nine sites across Alberta in 1993. The project will continue through the 1994 and 1995 growing seasons. Information collected from the first two years of field and greenhouse research is already helping agronomists fine tune their clients direct seeding systems.



The attached figure, canola on a sandy loam soil, shows that the wider the spread of fertilizer and seed in the seedrow the safer the crop. At 7 percent seedbed utilization (SBU) emergence was close to zero. The figure also shows that the better the seedbed moisture the faster the germination and the safer the crop.

Does the same hold true for cereals. The table shows some results with Brier barley. Emergence goes down as seedplaced urea goes up for both the 10 percent SBU and the 50 percent SBU openers. The loss of emergence was substantial at 67 and 89 pounds urea nitrogen with the narrow opener. The crop seeded with the narrow opener was later maturing and there was no yield benefit from the last increment of nitrogen. The highest rate of nitrogen reduced emergence slightly when the crop was seeded with the wider spread openers, but there was no effect on maturity and yield increased.

Effects of Seedplaced Urea on Brier Barley

Seedplaced Urea	Emergence 10% SBU	Emergence 50% SBU	Days to Maturity 10% SBU	Days to Maturity 50% SBU	Yield 10% SBU	Yield 50% SBU
(lbs N/acre)	(plants/m2)				(bu/acre)	
0	160	163	102	103	75	77
22	150	169	102	102	90	84
45	136	165	103	102	92	98
67	105	150	106	102	108	110
89	77	124	110	103	108	121

Average of two central Alberta sites 1993. Seedbed moisture was very good.

These examples show that a number of factors affect the amount of nitrogen that can be safely applied in the seedrow. These include:

- *Spring Seedbed moisture* - A moist soil provides a great deal of safety while a dry soil allows almost none. Seedbed moisture conditions can change rapidly. For example, seedbed moisture was excellent when seeding started in 1993. But conditions were poor by the time the last fields were being seeded. Field by field evaluation is critical.

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RESEARCH PROJECTS 94

Soil and Crop Management Branch will have an active field and laboratory research program during 1994 (see table below). Field projects are located at various sites around Alberta and address a wide variety of issues in the area of soil, crop and pest management. For more information on project locations and objectives call Joan Seath, 427-2530 or contact the research contact listed with each project.

PROJECT NAME	CONTACT PERSON
Dry bean production technology	Ross McKenzie
Long term dryland crop rotation trials	Ross McKenzie
Winter wheat fertilizer trials	Ross McKenzie
Dryland grass-alfalfa fertilizer trials	Ross McKenzie
Pea production project	Ross McKenzie
Optimizing barley silage production	Ross McKenzie
Manure and groundwater quality	Ross McKenzie
Optimal fertilizer with air seeded crops	Elston Solberg
Precision farming systems to minimize environmental impacts	Doug Penney Dan Heaney
Systems approach to toadflax control	Denise Maurice
Control of take-all in wheat	Denise Maurice
Forage cultivar evaluation	Denise Maurice
Pea cultivar evaluation	Denise Maurice
Investigation of herbicide resistance wild oat populations in Alberta.	Denise Maurice
Nitrogen, tillage and weed management	Denise Maurice
Crops of Alberta demonstration plots	Denise Maurice Camille Decharme
Control of field scabious	Denise Maurice
Tolerance of forages to experimental and newly registered herbicides	Dan Cole
Minor use data collection for label expansions in forage weed control	Dan Cole
Evaluation of Pursuit for broad specturm weed control in legumes	Dan Cole
Control of established alfalfa in pasture and reduced tillage land	Dan Cole
Control of narrow-leaved hawk's-beard in newly seeded hayland	Dan Cole
Integrated control of pasture and hayland weeds	Dan Cole
Tansy effect on forage productivity	Dan Cole
Biological control of perennial weeds	Dan Cole
Effects of soil management and erosion on emission of greenhouse gases	Elston Solberg
Determining erosion costs using simulated erosion plots	Elston Solberg

PROJECT NAME	CONTACT PERSON
N source (fertilizers, manure, legumes and soil) and environmental risk	Elston Solberg
Crop diagnostics for the 21st century--Field School and Greenhouse	Elston Solberg
Long Term Copper Trials	Elston Solberg
Long Term Phosphorous Trials	Elston Solberg
Interaction effects of Se, S and N on yield and quality of forages	Jerome Lickacz
Effect of sulphur sources on selenium uptake in forages	Jerome Lickacz
Interaction of date of harvest and fertilization on regrowth of timothy	Jerome Lickacz Elston Solberg
Sulphur sources and yield of forages	Jerome Lickacz
Phosphate fertilization on legumes	Jerome Lickacz
Soil compaction: Calibration of penetrometer resistance to crop yield	Jerome Lickacz
Deep tillage of solonetzic soils	Jerome Lickacz
Variety testing (cereals, oilseeds, forages and special crops)	Jerome Lickacz
Yield limitations on Solonetizc soils (drought stress or nutrient imbalances)	Jerome Lickacz
Crop growth model for spring barley	Len Kryzanowski Elston Solberg
Combining agronomic/conservation modelling with GIS.	Len Kryzanowski
Determining protein fractions in forages using NIR	Hua Hsu
Control of Purple Loosestrife	Shaffeek Ali
Blackleg of canola in the Peace Region	Lorraine Harrison
Reducing unecessary seed treatments for wire worm control in cereals	Jim Jones
European cornborer phermone monitoring program	Jim Jones
Cutworm and armyworm phermone monitoring program	Jim Jones
Beuvaria bassianna for biological control of grasshoppers	Mike Dolinski
Lygus bug management in faba beans	Mike Dolinski

Blackleg Continued

How the disease is spread

Blackleg is spread by infected seed or by spores that are splashed about by rain or carried by the wind in the growing crop. Long distance spread of the disease across the prairies is through the movement of infected seed.

When blackleg-infected seed is sown, the seedlings develop lesions on the leaves or stems. These infections can quickly form spores which are spread by rain and infect nearby healthy seedlings. In a single season, one infected seedling could spread the infection to many surrounding plants. These blackleg infected plants result in infected stubble that continues to produce infectious spores (pycnidiospores) for 3 to 5 years.

Another kind of spore (ascospore) results from two distinct strains of the virulent blackleg fungus mating. Both strains have to infect the same plants in order to hybridize and produce this sexual spore. Infected canola stubble discharges thousands of these spores into the air from May until October. The spores are wind-borne and can travel several kilometres in the air before landing. If they land on canola or mustard plants in nearby fields, the spores can begin new infections and continue the disease cycle.

How the disease organism survives

The fungus overwinters on infected canola stubble and seed. Infected stubble can continue to produce blackleg spores for three to five years. Heaviest spore production (both kinds) comes from two-year old infected stubble. Blackleg can buildup during crop rotations on volunteer canola. Wild mustards may also harbour blackleg infestations.

How to prevent the introduction of virulent blackleg onto land

Purchase seed that has been tested for blackleg. A laboratory certificate will be issued for all seed lots that were tested for virulent blackleg and shown to be negative for the disease.

Treat all canola seed with recommended fungicides and lindane. Use recommended rates. Even if seed does test blackleg-negative, there could be a few infected seeds in the total seed lot. Fungicides effectively reduce seed-borne blackleg, but they do not guarantee a 100 percent control.

Follow good crop rotation practices. Do not grow canola on a field more frequently than once every for years.

Practise good weed control, particularly of **volunteer canola.** Blackleg can live from one year to the next on volunteer canola and wild mustards. A long crop rotation will be ineffective without good weed control.

Control of blackleg on infested land

To control blackleg on infested land you must adopt the following practices:

✔ Bury canola stubble as deeply as possible in the fall. Alternatively, where soil erosion is a problem, incorporate the canola stubble just before planting. This practice speeds stubble decomposition and reduces the disease infection potential in the field.

✔ In the following three seasons, use shallow tillage or direct seeding to avoid bringing infected canola residue to the surface. Additionally, plant non-host crops such as cereals, grasses, alfalfa, clover and pulses.

✔ If at all possible, avoid planting canola closer than one kilometre from infested land for three years.

✔ Keep infested land absolutely free of volunteer canola and any wild mustards. **Note:** You may have difficulty controlling volunteer canola in newly seeded alfalfa, clover and peas.

✔ Do not plant canola seed from infested land.

A revised fact sheet on blackleg of canola including color pictures of infected plants is available this spring (*Blackleg of Canola, Agdex 149/632-3*). Contact Publishing Branch, Alberta Agriculture Food and Rural Development, 7000-113 Street, Edmonton, Alberta, T6H 5T6 or District Offices of the Department. #

Accredited seed testing laboratories

These laboratories follow a uniform seed testing procedure for blackleg.

Alberta Wheat Pool
4722 - 39 Street, Camrose T4V 0Z5
Phone: 672-5571

Alberta Wheat Pool
9728 - 128 Avenue, Grande Prairie T8V 4J4
Phone: 532-8841

Brooks Diagnostics Ltd.

P.O. Box 1701, Brooks T1R 1C5
Phone: 362-5555 Fax: 362-5556

Newfield Seeds Limited
P.O. Box 100, Nipawin, Saskatchewan S0E 1E0
Phone: (306) 862-4678

Norwest Laboratories
9938 - 67 Avenue, Edmonton T6E 0P5
Phone: 438-5522

United Grain Growers Seed Division
P.O. Box 6030, Station C, Edmonton T5B 4K5
Phone: 479-2051

20/20 Seed Laboratories
Box 224, Nisku, T0G 2G0

PHOSPHATE FERTILIZER: An important Input for Prairie Crop Production

Ross McKenzie
Research Scientist-Soil fertility

Phosphorus - an essential nutrient

Phosphorus is an essential nutrient required by plants for growth. It is involved in the transport and conversion of the sun's energy into starches, sugars and other compounds. Phosphorus also plays a role in the absorption of other nutrients by plant roots and in transport of ions across cell membranes within the plant.

Phosphate Fertilizer Use

Most prairie soils were naturally low in plant available phosphorus. The benefits of seed placing phosphate fertilizer with wheat grown on fallow soil were first observed in Saskatchewan in 1927 by J. Mitchell. Use of phosphate fertilizer became common during the 1950's and dramatically increased in the 1960's and 1970's. The phosphorus supplying power of soils which have received consistent applications of fertilizer has gradually increased over the last thirty years. In the 80's, many farmers began wondering if they could rely on soil to supply their phosphorus and cut back on phosphate fertilizer use or eliminate it completely.

Research to answer producer questions

In 1991, we began a three year project titled "FIELD EVALUATION OF LABORATORY TESTS FOR SOIL PHOSPHORUS" to examine the need for phosphate fertilizer across Alberta. Our primary objective was to evaluate when spring wheat, barley and canola will respond to phosphate fertilizer. We established approximately 45 research sites each year for three years, throughout the cultivated areas of Alberta. We applied different rates of phosphate fertilizer and measured yield response. A number of different soil test methods were used to determine plant available phosphorus levels.

Our research group included Ross McKenzie, (Soil and Crop Management Branch, Alta. Agriculture, Lethbridge), John Harapiak and Norm Flore (Westco Fertilizers Ltd., Calgary), Doug Penney and Elston Solberg (Soil and Crop Management Branch, Alta. Agrculture, Edmonton) and Garry Coy (Field Services, Alta. Agriculture, Fairview) in the Peace River area. Dan Heaney coordinated laboratory analysis and Len Kryzanowski is the group's statistician and modeller.

In 1993, we received funding from the Alberta Agricultural Research Institute, Western Grains Research Foundation, Alberta Canola Producers Commission, Sherritt Gordon, Cominco, Westco and the Potash and Phosphate institute.

Trial results at over 400 sites (Table 1) shows that 84.4, 92.5 and 82.0% of wheat, barley and canola sites respectively responded to added phosphate fertilizer. An economic evaluation showed that over 70% of sites economically responded to phosphate fertilizer at a 2:1 ratio, meaning the last dollar spent on fertilizer still returned $2.00 in increased crop yield.

In 1991 we both banded and seed-placed phosphate in the treatments in southern Alberta. Seed-placed phosphate

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Table 1. Number of sites responding to phosphorus by crop and soil zone over three years (1991-93).

Crop	Response	Brown	Dk Brown	Thin Black	Black	Gray Central	Gray Peace River	Total
Wheat	Positive	8	17	16	18	6	10	75
	Marginal	3	13	11	6	6	8	47
	None	5	9	3	6	1	2	26
Barley	Positive	9	20	26	28	12	16	111
	Marginal	5	6	9	1	0	4	25
	None	2	2	2	3	1	1	11
Canola	Positive	5	4	6	12	7	10	44
	Marginal	8	14	11	7	5	6	52
	None	3	8	2	5	0	3	21

Positive - increase greater than 5 bu/acre, Marginal - increase 2 to 5 bu/acre, None - increase less than 2 bu/acre.

Phosphorus Continued

produced higher yields than banded phosphate at 33 of 55 responsive sites (Table 2). Banded phosphate was superior to seed-placed phosphate at only eight of the 55 sites. Both placement methods were equal at the other locations. Remember, cereal crops take up to 75% of their P requirements in the first 40 days after emergence. Also, soil P is less available to crops under cool, wet conditions. For these reasons, it is important to place phosphate as close to the seed as possible.

Table 2. Crop response to seed-placed versus banded phosphate in Southern Alberta (1991).

	Wheat		Barley		Canola	
	Fallow	Stubble	Fallow	Stubble	Fallow	Stubble
Total Sites	7	17	7	19	7	15
Responsive Sites	6	10	6	13	6	14
Seed-placed > Banded	4	6	4	8	5	6
Banded > Seed-placed	2	3	1	0	0	2
Seed-placed = Banded	0	1	1	5	1	7

Using research results to develop fertilizer recommendations.

Results have clearly demonstrated that wheat, barley and canola frequently respond to phosphate fertilizer. We are now correlating yield results from 412 research sites with seven different phosphorus soil tests to determine which tests are most effective at predicting crop response to added fertilizer. Predictive models will be developed for each crop based on soil zone and soil test method. These models will allow us to make much better phosphate fertilizer recommendations to prairie farmers. Results should be available for the spring of 1995.

Until this phase of our study is completed, it is my opinion that farmers should consider adding a maintenance application of phosphate fertilizer each year to replace the P that is removed be the crop. This will ensure that good soil P levels are maintained and that crops won't run short of phosphate during the growing season.*

Seedbed Continued

Seedbed Utilization (SBU) - Safety increases dramatically with increased SBU. Every machine is different so it's important to know the row spacing and how much scatter is provided by the openers. Press drills typically place seed/fertilizer in less than 10 percent of the seedbed. Direct seeding implements will use 25 to 100 percent of the seedbed.

Crop Type and Seed Quality - generally cereals are more tolerant than small seeded crops. Using the best quality seed possible is cheap insurance; safety is enhanced by using plump vigorous seed.

Nitrogen Source - for cereals, seedplaced ammonium nitrate (34-0-0) is much safer than urea (46-0-0). ***Canola growers beware!!*** New information clearly shows that seedplaced 34-0-0 is as harsh as 46-0-0.

Field/Soil Factors - generally safety increases as clay content and/or percent organic matter increases. On a field basis, the total amount of nitrogen that can safely placed with the seed will be limited by the poorest parts of the field.

There are no black and white answers when it comes to determining safe levels of seedplaced N fertilizer. However, if all of the above factors are considered each season; on a field by field basis you will have some idea of when you can push the envelope with higher nitrogen rates.

Elston Solberg
Research Agronomist

SOILutions is published three times a year by the Soil and Crop Management Branch, Alberta Agriculture, Food and Rural Development. Your comments on current contents, ideas and contributions for future articles are welcome. For further information phone, fax, or write *Dan Heaney*, Soil and Animal Nutrition Laboratory, 905 O.S. Longman Bldg., 6909-116 st, Edmonton, Alberta, T6H 4P2, Phone (403)427-6361, Fax (403) 427-1439 **OR** *Elston Solberg*, Soil and Crop Management Branch, Agronomic Research Unit, 6909-113 st, Edmonton, Alberta, T6H 4P2. Phone (403) 427-2530, Fax (403) 427-0133.